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ABSTRACT

Twenty Asian graduate students in the Electrical and Computer Engineering (ECE) program at the University of California, Santa Barbara (UCSB) were interviewed for this study. The study was divided into two parts. The first part asked the importance of various factors that were deemed to have influenced students' choices to study abroad, to study in the United States, and to study at UCSB. The second part of the study asked students to rate the importance of factors that might encourage them to seek employment in the United States or return home after completing their studies. Students were asked to rate the importance of various items using a questionnaire of 27 items; each item measured the importance of an aspect of the students' decisions. Although a wide variety of factors were found to motivate students, some items consistently generated high mean scores and low deviations. Important factors included: (1) quality of ECE programs in the United States; (2) the added educational dimension of study abroad; and (3) better information provided at U.S. universities. Most students planned to work in this country, though not necessarily permanently. Possible implications for the United States and for the countries sending these students are discussed. Contains 12 references. (Author/KM)

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Asian Electrical and Computer Engineers at a California University:

Why Are They Here ? Why Might They Stay ?

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March 1988

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ABSTRACT

Twenty Asian graduate students in the Electrical and Computer Engineering (ECE) program at the University of California, Santa Barbara (UCSB) were interviewed for this study. The study was divided into two parts. The first part asked the importance of various factors that were deemed to have influenced students' choices to 1) study abroad; 2) study in the USA; 3) study at UCSB. The second part of the study asked students to rate the importance of factors that might encourage them to seek employment in the US or return home after completing their studies. Students were asked to rate the importance of various items using a questionnaire. The questionnaire consisted of 27 items; each of these items measured the importance of an aspect of the students' decisions. The interviews indicated that a wide variety of factors motivated the students. However, some items consistently generated high mean scores and low deviations. The quality of ECE programs in the US was an important factor. Most students were also interested in the added dimension that study abroad brought to their education. A very important factor in choosing to study in the US was the better information provided by US universities. Most students planned to work in the US, though not necessarily permanently. The possible implications for the US and the countries sending these students were examined using this research as well as previous studies.

The purpose of this paper has been to elicit the expressed reasons why Asian graduate students in Electrical and Computer Engineering (ECE) chose to study in the United States. The focus of this study was Asian students at the University of California, Santa Barbara (UCSB). This paper also examined factors that may encourage these students to remain in the United States or to return home upon completion of their studies at UCSB. Student experiences and how they affect the decision to return home or remain in the United States were also explored. The College of Engineering at UCSB is considered one of the best in the nation and is rapidly increasing its research facilities (Graham, 1988, p.1). The largest enrollment within the college is in the Electrical and Computer Engineering program. It is rated among the top 20 of 223 similar programs in the United States (Gourman's, 1985, p.32, p.16). International students make up one-third of total graduate enrollment within this major. Ninety percent of these students are Asians.

In the past year increasing media attention has been directed at the large numbers of Asian students who are earning graduate degrees from engineering schools in the United States (Bowen, 1988, p.65). This situation has existed for some time. However, it has only recently been deemed of sufficient interest to warrant the attention of the national media. This increased interest may stem from the fact that most doctorates are now awarded to candidates from abroad (GAO, 1986, p.7). United States' engineering schools represent the leading edge of technical training in many fields, such as electrical engineering, and the related field of computer engineering (Bowen, 1988, p.65). No other type of professional education in the United States draws so many international students (Zikopoulos, Julian and Goodman, 1987, p.27). Why these students find this field of study so attractive seems a question worthy of further study.

Statistics compiled by the National Science Foundation (NSF, 1986) show that many international graduates in the fields of engineering, computer science and mathematics will remain in the United States to work in their fields of study. The more advanced the degree earned, the greater the propensity to stay and seek employment. The majority of students receiving doctorates in the above mentioned fields have chosen to stay in recent years. Evidence shows that this trend is accelerating. Those with doctorates in computer science were the most likely to stay in

the United States. Statistics show that 79% of those receiving this degree in 1984 elected to remain in the US (GAO, 1986, p.4). The results of the NSF study corroborate the main conclusions of earlier research by the National Research Council and the Social Security Administration (Barthel and Early, 1985, p.28).

While it is well established that increasing numbers of international students study in these areas and go on to work within these fields in the US, this author found few studies that have systematically examined the factors that attract these students or the factors which encourage them to remain in the US. The present study was conducted in order to gain a greater understanding of two major questions: 1) Why do these students chose to undertake graduate study in the United States? ; and 2) What factors are important in their decision to return home or stay in the US upon completion of their studies?

Survey Method

The questionnaire used in this survey was divided into two parts. The first part asked students to rate the importance of various factors that may have influenced their decision to attend UCSB. The second part asked students to rate the importance of factors that may influence their decision to return home or seek employment in the United States. (See Appendix A)

Information for this study was gathered by researching students' ideas and thoughts via prepared questions. The questions were designed to elicit a response to an aspect of the students' motivation in regard to their decision to study ECE at UCSB. A preliminary survey involving ten students was preformed to estimate the relevance of various questions. (These students were not included in the main survey sample.) Four sources aided the author in generating specific items. These were Zikopoulos and Barbers' (1986) research on the educational choices made by students from South and East Asia, administrators who work with international students at UCSB, a report by the General Accounting Office summarizing trends from a 1986 NSF study, and the author's ideas and prior research on international students.

Part one of the questionnaire included sixteen items generated by all four sources. Zikopoulos and Barbers' (1986, p.45-46) research on the educational choices made by students from South and East Asia study found the four most prevalent reasons expressed by these students for choosing to study in the US were the following: 1) the quality of US universities; 2) instruction in English; 3) better information on programs provided by the US schools; 4) and the prestige of a US degree. In addition their study found the most important factor in choosing between two US schools to be the reputation of the department and the school. Their conclusions helped generate questions 2,5,7,6, and 11, respectively. Conversations with administrators resulted in questions 3 and 4. The GAO report was important in generating item 9. Questions 1,8, and 10-16 were deemed plausible reasons for Asian students to chose graduate study abroad at UCSB. (For an explanation of each item see Appendix B).

The questions were divided into three groups. These groupings represented possible cognitive stages in Asian students' decisions to study abroad at UCSB. Some items measured the same aspect of this decision within a different stage. Each of these groups includes academic as well as personal reasons that may have been important in the decision to study at UCSB. Questions within each group begin with those that are academic and are followed by those deemed personal reasons.

Questions 17-27 formed part two of the questionnaire. These items were based primarily on the author's ideas of factors which would be important in a student's decision to return home or remain in the US. Conversations with administrators were important in generating questions 24 and 26. Information contained in the GAO report resulted in item 20 being included. (For an explanation of each item see Appendix B).

Form of Administration

A closed-form questionnaire seemed the best way to gain an understanding of students' motivations in choosing to study in the US. There are many aspects involved in a decision-making process that takes a student from Asia to a US University. It seemed reasonable to assume more information and greater understanding would result from questions that asked the student to measure the importance of a specific aspect of the decision. An open-form would likely result in answers involving only

one or two aspects of the decision. With the closed-form various aspects of a student's motivation can be readily compared to each other to determine their relative importance. In addition, since interviewees came from different cultures it seemed that an open-ended questionnaire might result in diverse information that might not be easy to compare. The closed-form seemed the best type of questionnaire to employ due to the wide variation of responses anticipated. Its chief benefit is that the data produced is readily comparable. An inherent disadvantage of the closed-form is that it may lessen depth of response. To compensate for this disadvantage students were encouraged to comment on any question or expand on their answers. This was done before beginning the interview and whenever the author perceived that the student did not feel the question or answer given was getting to the essence of the question at hand. The questionnaire asked students to indicate the relative importance of factors in their decision by marking one of five equidistant points on a line in response to an item. This continuum extended from the left beginning with "not important" through "somewhat important" to the right which was labeled "very important." One variable inherent in a scale of this type is the interviewees' interpretation of the terms used.

The students were interviewed face-to-face. Telephone interviews seemed less viable because of their disadvantages. The author assumed that international students might be suspicious of a stranger who wanted to ask them questions over the phone. They might refuse to be interviewed at all. Language difficulties might also be a problem in some cases. Face-to-face interviews appeared to assure the interviewees that they were talking to another graduate student who was interested in their situation, rather than a representative of an organization that might expel them from the country or was "checking up" on them. One disadvantage of personal interviews was that students might be reluctant to indicate they were planning to remain in the US or had intended to immigrate in the presence of a US citizen. However, the author was somewhat surprised to find very few instances of reluctance to answer these question. In the opinion of the author the majority of the interviews were characterized by candor. Despite the possible drawbacks, the personal interview was deemed the best way to gather information.

Sample of Respondents

The department of ECE at UCSB enrolls students from most of the primary sending countries of Asia. For this study, however, only students from the Republic of China (Taiwan), India and the People's Republic of China (PRC) were interviewed. These nationalities represent two-thirds of the international graduate students in the department. After these three groups, the next largest nationality represented less than a tenth of total international graduate enrollment in the program. It seemed reasonable for this study to concentrate on nationalities that were well represented in the program and to avoid those that only provided one or two students.

Interviewees were chosen by nationality and program (M.S. or Ph.D.) to secure a survey group representative of the three largest nationalities and programs vis-a-vis each other (table 1). The author conducted twenty interviews which were evenly divided between Ph.D. and M.S. students. Fifty percent of each nationality's students' were interviewed, with the exception of an uneven number (table 2). Other than these controls, the students interviewed were those most easily contacted by phone. No students declined to be interviewed. Two said they were too busy to make an appointment at the time they were called but that they would call the author back to make an appointment at a later date. They were not heard from again and no further efforts were made to contact them. Students were selected from information provided by the Office of International Students and Scholars at UCSB. International students comprise one-third of the ECE program.

Table 1

All International Graduate Students in the Department of ECE at UCSB

<u>Nationality</u>	<u>Students</u>
India	17
Republic of China	16
People's Republic of China	8
Other Asians	16
Non Asians	8

Table 2

Students interviewed by nationality and degree program.

<u>Nationality</u>	<u>Ph.D.'s</u>		<u>M.S.'s</u>	
	Total	Interviewed	Total	Interviewed
India	11	/ 5	6	/ 3
Rep. of China	4	/ 2	12	/ 6
People's Rep. of China	6	/ 3	2	/ 1

Administration

All student interviews used in the preparation of this paper were performed during the first three months of 1988. Ninety percent of the interviews for this study took place on the Santa Barbara campus of the University of California. Of these, three-fourths were performed in the library. The remainder took place in the offices of the students interviewed. Interviews performed off-campus took place in the students' homes. Most interviews took between twenty and forty minutes.

Students were met, and the purpose of the interview was explained before it began. The author mentioned the results of the NSF study to the students to convey a sense of interest and prior knowledge of the situation of Asian ECE students. In the opinion of the author, this introduction encouraged greater candor during the interview process. The interviewees were told their identities would remain confidential and were shown that the questionnaire did not ask for their name. Before beginning the interview, students were encouraged to expand on their answers beyond simply filling out the questionnaire. It was explained that these comments could be recorded more easily if the student expressed them

immediately after answering the question that brought them to mind. A sample question was demonstrated to assure the process was understood. Students were told they could assign the same relative importance to as many factors as applicable. They were also reminded that the questions were testing only the importance of an aspect of their decision, not whether the question was true or false or whether it was true of other students. The interviewer read the questions to the students, and they marked the continuum. Students were also reminded that they could elaborate on their answers during the interview if it was perceived that students had something to add but were inhibited. The students were allowed to view the list of questions at any time during the interview if they desired.

The only problems perceived by the author in administering the questionnaire were language difficulties. These were dealt with by promptly restating the question in different words if it was perceived that the student did not understand. For example the word "homeland" would be restated as "country" or "nation." If a Chinese student seemed not to understand "live in home culture", the interviewer would prompt the student with "live where everyone speaks Chinese." All students that were asked believed that the questionnaire successfully identified their reasons for study abroad at UCSB.

Comments on Results

In a study as specific as this one, care must be taken to avoid the tendency to generalize results beyond the strict confines of the group surveyed. UCSB's ECE Department may not be representative of other departments within this field, or even of others within University of California system. During the course of this research it became obvious that the reasons that motivate students to study at UCSB vary greatly and are often quite personal. The different nationalities involved in this field of study increase the diverse nature of responses.

Results of Part One: Student Choices

Table 3

<u>Study abroad versus study at home.</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
>>>How important was each of these factors in your decision to study abroad rather than at home?			
1. An area of study which was unavailable in your homeland.	2.6	0.66	5
2. Quality of program was better than in homeland. (any reason)	3.4	1.40	4
3. Gaining experience in a foreign setting.	3.7	1.43	5
4. Less competition for admission to program.	1.6	1.32	5

Comments on Table 3

The students' responses within the first group of questions established the importance of adding another dimension to their education by studying in a foreign setting. This was reflected by item 3, which asked the importance of "Gaining experience in a foreign setting." This item generated the highest mean score and the lowest standard deviation in the group. Within the first four items, this one was assigned the highest score by all three nationalities. The other three items in the first set of questions were deemed more academic reasons. Foremost among these academic reasons for study abroad is the perception that the program of study is superior to the one available at home (item 2). A significant but substantially less important perception was that the area being studied abroad was not available at home (item 1). Students from the PRC reversed the importance of these items. The fourth item inquired into the importance of less competition for admission. This was a consideration for small minority of those surveyed. Among this minority, it was sometimes more or equally important than the preceding questions.

It seems reasonable to conclude from responses to the first three questions that most students surveyed "chose" to study abroad for personal and academic reasons. This contrasts with the possible view that these students are in some sense "driven" to study abroad because the education they desire is not available at home.

Table 4

<u>The United States and study abroad.</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
>>>In your decision to study in the United States rather than another foreign nation how important was each of these factors.			
5. A desire to use or improve English skills.	2.7	1.48	5
6. The high prestige of a degree from the United States.	3.4	1.00	5
7. Better information was available in your country about ECE programs in the U.S.	4.1	0.81	5
8. Parents or family have studied or live in the U.S.	2.3	1.50	5
9. A desire to get a job in the United States in your field of study.	2.6	1.44	5

Comments on Table 4

The second set of questions measured the importance of possible reasons for choosing to study in the US. Comments added by students in response to these items indicated that within their field very few considered study abroad in any country besides the US. The better information provided by US schools is likely a factor here. On the questionnaire the item that measured the importance of this information recieved the highest mean and lowest deviation ratings within this set (item 7). Seventy-five percent of Indian students assigned this item a rating of five, the highest possible. The prestige associated with a US degree was the next most

important reason, as measured by item 6. Following these two items in importance was question 5, which rated the importance of the English language in the student decision to study in the US. The comparatively low value assigned item 5 surprised the author, especially since students from India rated this item lower than the other two nationalities. Possible illumination in regard to this value came from an Indian student who noted that "Most Indian graduate students do not feel they need to improve their English and if instruction in this language is important they have other options besides the US." These three highest rated items were generated primarily by Zikopoulos and Baker's research (1986) on Asian students. However, the values assigned by interviewees in this survey resulted in a ranking of importance among these items which did not directly correspond to their conclusions. These differences may stem from the peculiarities inherent in a survey group as specific as this one. The spread between the mean scores for all three of these items was substantial.

Only slightly less important than English language was the desire to work in the US in the students' field of study (item 9). Indian students assigned a higher value to this item than other nationalities. The mean response of Indians to this item was 3.62. Question 8 measured the importance of familial ties in deciding to study in the US. This item had the lowest mean score of any in this group. The interviewees tended to put the importance of this aspect at either end of the scale. By nationality PRC students were skewed towards the high-end of the scale and Taiwanese students towards the low-end. This aspect was also explored in question 14.

Table 5

<u>UCSB versus other US Universities.</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
>>>How important was each of these factors in your decision to study at UCSB? (Compared to other US Universities)			
10. Area you wanted to specialize in was available at UCSB.	3.4	1.38	5
11. The reputation of UCSB's ECE department or of the UC system in general.	3.5	1.16	5
12. UCSB is close to major research institutions and employers.	2.6	1.26	5
13. A Scholarship, Fellowship, or Research funding was awarded to you.	3.3	1.70	5
14. Parents or family have studied at UCSB or live nearby.	1.9	1.77	5
15. Cost of education is less expensive than other universities in the United States that you considered, not counting graduate aid.	1.6	1.04	5
16. The local climate and environment are pleasant.	3.4	1.15	5

Comments on Table 5

The final group of questions in part one of the questionnaire asked students the importance of factors that may have been important in their decision to study at UCSB. The seven items resulted in a clear break between four with comparatively high means, two generating low numbers and one in the middle.

One of the items that generated mainly mid to high responses was 16, which measured the importance of Santa Barbara's pleasant climate and environment. Most students had some idea of Santa Barbara's climate before they arrived. Many expressed a desire to study somewhere in California. The other schools mentioned by students tended to be in the Northeast US and students often mentioned they were not used to cold

weather and did not wish to experience it. If they were accepted by UCSB as well as universities in other states this item tended to be fairly important. Other items which generated high mean scores and little differentiation along national lines were 10 and 11. These items measured the importance of an area of specialization available at UCSB and the reputation of the department or the UC system in general. One student commented on item ten. He said his special area of study was an important consideration in attending UCSB, but added that "Very specific information is not available, you end up guessing." Another commented that analyzing the information provided is "tricky."

The fourth highest mean score was generated by item 13, which asked students the importance of graduate funding in their decision. Responses to this item clustered at both ends of the scale depending on whether students recieved aid or not. This resulted in the second highest standard deviation in this study. Some students seemed to believe that it was easier for international students to recieve graduate aid in other states.

UCSB's proximity to major research institutions and employers was somewhat important to most students (item 12). Many Asian students seemed to believe that schools in California were likely to be involved in emergent areas of research. Others were interested in working in California and thought it would be advantageous to study in the area first.

Items 14 and 15 generated the lowest mean scores. The highest standard deviation resulted from item 14 (family near UCSB). As expected, responses were skewed towards one end of the scale or the other. Two of four PRC students assigned this question the highest importance possible. Their family in the area were spouses who were already graduate students at UCSB. Some Indian interviewees assigning high importance to this item. The family they refered to were relatives already residing in the Los Angeles area. At least one of these could probably be termed a "hidden immigrant." Mehrabi (1986, p.13) used this term to describe a student who would probably come to the US even if earning a degree was not a factor. Over half of interviewees gave the lowest rating to item 15 (cost). The few responses in the middle range and the one at the high-end of the scale were students who had considered private institutions.

Results of Part Two: Return home or seek employment in the United States.

17. After you graduate do you plan to return to your homeland or seek employment in the United States?

	<u>% Responses</u>
A. Return	30
B. Seek Employment	20
C. Undecided/ Other/ Both A & B	50

Comments on Item 17

This part of the study explored factors that may be important in students' decisions to return home or work in the US upon completion of their studies at UCSB.

Item 17 divided students into three groups depending on their post graduation plans. Six students said they would return; they were asked to respond to items 18 through 21. Four planned to seek employment in the US; they answered items 22-27. The other ten students chose C in response to this question. All but one of these students said they planned to work in the US and return home at a latter date (the other one was undecided). Students explained this decision in different ways. Most were primarily interested in work experience or wanted to make sure their education had taught them everything they believed they needed to know before returning home. Others wished to work here and save money so they could return home with sufficient money to start a business or buy a house. Students selecting C were asked how important items 18 through 27 were in the decision to work in the US now and return home later. Responses to item 17 showed strong differentiation among nationalities. Three of four PRC students chose A; none of the Indians did. Taiwanese students were almost evenly divided between A and C.

Table 6

<u>Reasons expressed for returning.</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
How important are these factors in your decision to return to your homeland?			
18. A desire to return to family and friends.	4.3	1.29	5
19. A desire to live in home culture.	3.6	1.27	5
20. Employment in area of emphasis within ECE is unavailable in U.S.	1.2	0.66	3
21. Skills learned in UCSB's ECE department are needed in homeland.	3.9	0.82	3

Comments on Table 6

A total of sixteen students responded to items 18-21. Their answers showed little difference among nationalities. The desire to return to family and friends (item 18) and the home culture (item 19) were both important. All students placed a mid to high importance on applying their skills at home (item 21). Item 20 measured whether students believed they had to return home because employment in their field was not available. This item recieved the lowest mean score of any in the survey. All but two interviewees rated it "not important." The two that believed it somewhat important explained that most employment in their field was defense related and that they needed US citizenship to get these jobs. These comments and the low mean and deviation in response to item 20 convinced the author that almost all students believed they could work in the US if they desired to.

Table 7

Reasons expressed for seeking employment in the United States.

	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
How important are these factors in your decision to seek employment in the United States?			
22. Family, friends or spouse now in the United States.	1.7	1.16	5
23. Preference for lifestyle or culture in the United States.	2.0	1.07	4
24. Employment in your area of study is unavailable in your homeland at this time.	2.3	1.48	5
25. Financial benefits and living conditions in the United States are better than at home.	3.6	1.28	5
26. A desire to continue research or work towards a higher degree.	3.3	1.56	5
27. Current political or economic trends in your homeland that are unfavorable.	2.2	1.14	4

Comments on Table 7

The second group of questions in this part of the survey asked students how important various factors were if they planned to seek employment in the US. Indian students comprised over half the fourteen respondents to items 22-27. Two of these items were substantially more important than the rest. The first measured the financial benefits and better living conditions in the US (item 25). This generated the highest mean score. The next highest measured the desire to continue research or work towards a higher degree (item 26). It seems likely that students might have difficulty continuing their studies at home. This can be a powerful stimulus to remain in the US for a technophile. A related item measured if students believed that employment in their field of study

would be unavailable at home (item 24). This generated a comparatively low mean of 2.3; though it was very important to some students. The mean for Indian students (most are Ph.D.'s) was considerably higher than Taiwanese (most of whom will receive M.S.'s). Comments revealed that most students believed they could find employment, though they might wait a few years before knowledge at home "caught up" to their expertise. Unfavorable political or economic trends at home were of fairly low importance to most students, especially Indian ones (item 27). Less important motivations for working in the US were preference for the culture (item 23) and family ties to the nation (item 22).

Conclusions

The diverse reasons offered by students in explaining their study abroad at UCSB highlight the importance of personal aspects in this decision. In the opinion of the author, the Asian graduate students in ECE are highly motivated people. If they were not they would likely spare themselves considerable expense and effort and stay home. Most students were at least in part motivated to study abroad by the the personal growth associated with living and studying in a foreign setting. Some already had relatives in the US or may have considered immigrating before they arrived. Others may experience growth in directions that encourage them to remain in the US.

One of the key issues arising from a study such as this one is the question of how students' decisions affect the United States and their home countries. In the opinion of the author, when ECE students study in the United States they contribute to the nation in a number of ways. This contribution continues if they remain in the US. Research by Baker, Michael, Schmitz, Harrison, (1987), Barthel and Early (1985), and Mehrabi (1986) support these interpretation. Some of their relevant finds will be dicussed in the next section.

The implications created by this flow of students for the sending countries will also be commented upon. Impressions formed by the author during the course of this research will receive special attention.

Benefits to the United States from non-returnees.

Research has shown that international ECE students benefit the US in a variety of ways. These benefits increase if students apply their skills in the US after graduation. The inflow of scientific talent provides tangible benefits to various sectors of the US society. Particularly notable is the contribution to academic institutions. Graduate theses and dissertations are a valuable form of unpaid research (Mehrobi, 1986, p.8). Foreign nationals study in the top ranked programs as well as the less distinguished ones. There is no doubt that enough U.S. citizens seek advanced degrees to maintain the highest rated institutions, however, many other graduate engineering programs would shrink or be forced to close if the aggregate number of students declined. The tendency of native born undergraduates to eschew graduate study in favor of immediate entry into the workforce is well documented. Barthel and Early (1985, p. 3), compared U.S. and foreign undergraduates with engineering degrees. Only 20% of U.S. citizens with a B.S. in engineering were interested in continuing their studies at the time of their graduation. This contrasts with international students in the same field, two-thirds of whom enter graduate programs. Clearly, international students are vital in maintaining graduate programs in many scientific fields. These programs and the professionals they educate are a necessity if the US is to remain competitive in some of the most rapidly changing areas of information technology.

The economy of the United States also benefits substantially from advances in these fields. Exports derived from research in these areas are a plus in the nations' balance-of-payments figures. Mehrobi (1986, p.11) calculates that the costs incurred in educating international students is \$3.8 billion less than their annual contribution to the US economy. The principal benefit in his figures is "capital embodied in non-returnees." If one were to make the extremely dubious assumption that non-returnees contribute nothing to the economy, the total subsidy to all international students including scholarships and other forms of funding would be \$280 million. Obviously, a cost-benefit analysis of international students is highly dependent on the information consulted in the study. It must be

remembered that students from abroad most often pay their own way while in the United States (Baker, 1987, p.73). Tuition is normally three times what a resident would pay at a large state university (Graduate Division Announcement UCSB, 1987, p.25). Unlike US students from out-of-state, foreign nationals will continue to pay nonresident tuition every quarter or semester they are enrolled, year after year. Charges that international students are a burden on the US economy remain unsubstantiated and dubious (Baker, 1987, p.73 & Mehrabi, 1986, p.14). There is virtually no evidence that foreign-born engineers contribute to unemployment in the United States (Bowen, 1988, p.65). Some authors also believe that educating foreigners provides many intangible long-term benefits to the US and its' people. (Mehrabi, 1986 & Baker, 1987, p.73)

Although the United States maintains its lead in ECE and other computer related fields, this lead is a slim one (Feigenbaum and McCorduck, 1983, p.71). Many factors could erode this advantage. Any decrease in the number of scientists entering the laboratories could be detrimental. International students now make up 36% of the new Ph.D.'s entering the workforce (Barthel and Early, 1985, p.28). Nearly one in five US engineers is foreign born, though most are naturalized citizens (Samuelson, 1988, p.53). A strong case could be made that despite the excellent engineering schools and many outstanding graduates, the United States still does not have enough engineers in some crucial fields. Evidence for this proposition exists in the statistics which show that foreign engineers who graduated from schools outside the United States continue to arrive and find employment (Barthel and Early, 1985, p.29). In what is commonly known as the "silicon valley" region of California, some managers report that 1/3 of the engineers employed by their firms are foreign nationals and "We would close without them" (Barthel and Early, 1985, p.26). It is difficult to imagine the computer related industries in the United States prospering as they have without the significant contributions made by international students.

The implications for home countries.

The implications for the home countries of these non-returning students are not entirely clear. Certainly this "brain drain" does result in a loss of scientific talent for the country of origin. There are other, less obvious, aspects to this phenomenon, though. Many ECE students have

advanced their knowledge about as far as they can in their homeland. A returnee may represent talent in a field that would not exist otherwise. Mehrani (1986, p.16) indicates that increased skill embodied in returnees more than offsets the loss in total students. Students that remain in the US represent the negative side of educational flow that may benefit technical development in the sending country. Non-returnees can represent an intrinsic inefficiency in international education. The student that chooses to stay in the US, however, may not be a total loss to his country of origin. Contacts may be maintained with colleagues in the home country for a lifetime. This may represent a channel for knowledge dissemination to the country of origin. In addition, it became obvious to the author during the course of these interviews that it was erroneous to assume that a US educated engineer who stays represents one less engineer in the sending country. One student commented "I would not use my degree if I were at home. It's the same at home as it is here, the commercial and managerial professionals can make more money than engineers. My decision to study and remain in the US had little to do with money, I'm here mainly because of my interest in this field."

The choices made by this student and others like him have implications for scientific development and technology in the world as a whole. This study was undertaken to gain a better understanding of students' choices in an area that has importance for those interested in information technology. The author hopes that some light has been shed in this area, and that further research will result in a greater understanding of these important questions.

Appendix A

Students were asked to rate the importance of these factors in their decisions.(Words in parenthesis were used to clarify questions or prompt students.)

How important was each of these factors in your decision to study abroad rather than at home?

1. An area of study which was not available in your homeland.
2. Quality of program was better than in homeland. (any reason)
3. Gaining experience in a foreign setting.
4. Less competition for admission to program. (than in home country)

In your decision to study in the United States rather than another foreign nation how important was each of these factors.

5. A desire to use or improve English skills. (Already know language or want to learn it.)
6. The high prestige of a degree from the United States. (prestige = "honor")
7. Better information was available in your country about ECE programs in the U.S. (Easy to get information on US schools.)
8. Parents or family have studied or live in the U.S.
9. A desire to get a job in the United States in your field of study.

How important was each of these factors in your decision to study at UCSB? (Compared to other US Universities)

10. Area you wanted to specialize in was available at UCSB.
11. The reputation of UCSB's ECE department or of the UC system in general.
12. UCSB is close to major research institutions and employers.
13. A Scholarship, Fellowship, or Research funding was awarded to you.
14. Parents or family have studied at UCSB or live nearby.
15. Cost of education is less expensive than other universities in the United States that you considered, not counting financial aid.
16. The local climate and environment are pleasant. (Did you know this before you arrived?)

Part Two

17. After you graduate do you plan to return to your homeland or seek employment in the United States?

A. Return B. Seek Employment C. Undecided/ Other/ Both A & B

Reasons expressed for returning.

Asked of those who chose A. (Students who chose C were asked how important these factors will be if they choose to return home.)

How important are these factors in your decision to return to your homeland?

- 18. A desire to return to family and friends.
- 19. A desire to live in home culture. (Speak your native language.)
- 20. Employment in area of emphasis within ECE is unavailable in U.S.
- 21. Skills learned in UCSB's ECE department are needed in homeland.

Reasons expressed for seeking employment in the United States.

Asked of those who chose B. (Students who answered C were asked "if you do seek employment in the US how important will these factors be?")

How important are these factors in your decision to seek employment in the United States?

- 22. Family, friends or spouse now in the United States.
- 23. Preference for lifestyle or culture in the United States.
- 24. Employment in your area of study is unavailable in your homeland at this time.
- 25. Financial benefits and living conditions in the United States are better than at home.
- 26. A desire to continue research or work towards a higher degree.
- 27. Current political or economic trends in your homeland that are unfavorable.

Appendix B

Explanation of individual items in Questionnaire.

>>> Items 1 thru 4 asked possible reasons for initial consideration of study abroad.

1. Measures the desire to go abroad for an education deemed unavailable at home.
2. Measures the desire to go abroad for an education deemed superior to the one available at home.
3. Gaining experience in a foreign setting is a possible reason for going abroad.
4. Some students may hope they will face less competition for admission.

>>>Questions 5 through 9 asked reasons for selecting the United States for graduate study.

5. Measures Zikopoulos finding that English was the second most often cited reason South and East Asians selected the United States.
6. Measures the importance of prestige in selecting the United States.
7. Zikopoulos found that better information was the third most often cited reason South and East Asian selected the United States.
8. Measures the importance of possible familial ties to the host nation.
9. Considering how many ECE students eventually do work in the US this seemed a worthwhile question.

>>>Items 10 through 16 asked reasons for choosing to study at UCSB.

10. measures how important an area of specialization was in students' selection of UCSB.

11. This item is based on Zikopoulos' finding that the reputations of the department and the school are the most important considerations when choosing between two US schools.

12. Measures whether UCSB's proximity to major research institutions and employers was a factor in students' decisions.

13. Measures the importance of financial aid and funding in student decisions.

14. Measures whether familial ties influenced students to study at UCSB.

15. Measures whether UCSB was less expensive than other (presumably private) schools.

16. Measures how important the pleasant climate and environment at UCSB were in student decision making.

Part Two: Return Home or Work in the United States

Question 17 asked students whether they plan to return to their homeland (A), stay in the United States (B), were undecided, both A & B, or had other plans (C). Students that chose A or B were then asked to rate the importance of various factors in their decision by answering one of two groups of questions. Those that chose answer C (Undecided/ Other/ Both A & B) were asked to elaborate on their response and to answer both groups of questions. (International Students may have various reasons for declining to state they plan to remain in the US.)

>>>Questions 18 through 21 asked students to express the importance of possible reasons for returning home.

- 18. Measures how important family and friends were in this decision.
- 19. Measures students' desire to return to home culture.
- 20. Measures if students feel they must return because they believe they cannot find work in the US in their field of study
- 21. Measures if students want to return home because the skills they learned at UCSB are needed at there.

>>>Items 22 through 27 asked students to express the importance of possible reasons for seeking employment in the US.

- 22. Measures the importance of family, friends or spouse now living in the US.
- 23. Measures the preference for the lifestyle or culture of the US.
- 24. Measures whether students can find employment in their field of study at home.
- 25. Measures the importance of US financial and living conditions.
- 26. Measures whether students desired to continue their education in the US.
- 27. Measures whether unfavorable political or economic trends encourage students to remain in the US.

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